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Matériel Test Procedure 4-4-004
U. S. Army Arctic Test Center

U. S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

ARCTIC ENVIRONMENTAL TEST OF SMALL ARMS AMMUNITION

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide a means of evaluating the performance of small arms ammunition under arctic winter environmental conditions.

2. BACKGROUND

Engineering tests of small arms ammunition are conducted to determine the characteristics and performance of the ammunition under various conditions of operation, and to ensure their compliance with specified requirements. Testing in a natural arctic winter environment is used to substantiate or supplement data obtained from simulated tests conducted during the Engineer Design and Engineering Test phase. Testing in the arctic winter environment generally is not authorized until data from simulated environment tests provides reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the arctic.

3. REQUIRED EQUIPMENT

- a. Appropriate Arctic winter uniforms and individual field gear.
- b. Weapons as required.
- c. Ammunition as required.
- d. Standard American targets.
- e. Type A and B rifle targets.
- f. Appropriate bench rest and weapon bipods.
- g. Vehicles as required.
- h. Support aircraft.
- i. Drop zone.
- j. Air drop platforms and containers with parachutes as required.
- k. M1950 Parachutists individual weapon container (or latest standard containers).
- l. All general and special tools and ancillary items required to perform maintenance on the test item.
- m. Test equipment as required.
- n. Photographic equipment (black and white or color).
- o. Meteorological support facility.
- p. Rate of fire recorder.
- q. Shot group computer.
- r. Velocity coils.

4. REFERENCES

- A. AR 705-15, Operations of Materials Under Extreme Conditions of Environment.
- B. AR 705-5, Army Research and Development.

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- C. AR 70-8, Human Factors and Social Sciences Research.
- D. AR 70-10, Army Materiel Testing.
- E. AR 750-6, Maintenance Support Planning.
- F. USATECOM Regulation 705-2, Documenting, Test Plans and Reports.
- G. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.
- H. MTP 10-4-500, Arctic Preoperational Inspection, Physical Characteristics, Human Factors, Safety and Maintenance Evaluation.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP are designed to determine and evaluate the functioning characteristics of small arms ammunition under arctic winter environmental conditions.

The specific tests to be performed and their intended objectives are listed below:

a. Preoperational Inspection and Physical Characteristics - This test provides for an inspection of the test item to:

- 1) Identify damage received during shipping and handling.
- 2) Determine its physical conditions.
- 3) Determine if the test item dimensions, weight, and characteristics conform to applicable criteria.
- 4) Locate any defects.

b. Firing Test - The objective of this subtest is to determine the accuracy of small arms ammunition under arctic winter environmental conditions.

c. Velocity Test - The objective of this subtest is to determine the velocity of small arms ammunition at the muzzle of the support weapons under arctic winter environmental conditions.

d. Suitability of Tracer or Spotter Element - The objective of this subtest is to determine the suitability of the test cartridge for designating targets and adjusting fire on targets.

e. Position Disclosing Effect - The objective of this subtest is to determine and measure the position disclosing effect created by the cumulative smoke, muzzle flash, ice fog and sound of the test ammunition when fired under arctic winter environmental conditions.

f. Functional and Operational Suitability - The objective of this subtest is to determine the ease of carrying and transporting the test ammunition cross-country and over ski trails while wearing snowshoes and skis.

g. Aerial Delivery - The objective of this subtest is to determine the suitability of the test ammunition for Phase I airborne operations under arctic winter environmental conditions.

h. Human Factors Engineering - The objective of this subtest is to determine if all accessories and components of the test ammunition enable easy operation by test personnel wearing the appropriate arctic winter uniform.

i. Maintenance Evaluation - The objective of this subtest is to determine if the test ammunition meets maintenance and maintainability requirements as defined by QMR, SDR, TC, MC or other established criteria under arctic winter environmental conditions.

5.2 LIMITATIONS

The procedures described in this MTP are limited to the testing of small arms ammunition under arctic winter environmental conditions. Specific tests for other ammunition may be performed using this MTP as a guide with variations applicable to the ammunition to be tested, (30 MM and smaller caliber).

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Since arctic winter environmental tests are normally scheduled from October through March (6 months), ensure that the test items, test and comparison weapons are delivered to the Arctic Test Center prior to 1 October.

b. TDY personnel shall be used to augment assigned personnel and shall be trained to the degree that they are as proficient on the individual weapons as the troops who will use the weapon.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC), and record this criteria in the test plan.

d. Review all instructional material issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same type of equipment, and familiarize all test personnel available for reference.

e. Record the grade, MOS, background, and training of all test personnel and ensure that all personnel receive new equipment training (NET) as referenced in 4G.

f. Record the following information:

- 1) Nomenclature, serial number(s), and manufacturer's name of the test items.
- 2) Nomenclature, serial number(s), accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

g. Select test equipment ideally having an accuracy 10 times greater than that of the function to be measured.

h. Prepare record forms for systematic entry of data, chronology of test, and analysis in final evaluation.

i. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test. Ensure that a Safety Release has been obtained prior to test conduct.

j. Outfit all test personnel in appropriate arctic winter clothing

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as described in MTP 10-4-500, and with individual field equipment, during all ammunition testing.

k. Ensure that when not in use, all test and comparison ammunition are stored and maintained in an unsheltered area and exposed to ambient air temperature and prevailing weather conditions.

l. Record the prevailing meteorological conditions during the storage phase, as well as test conduct, to include:

- 1) Temperature
- 2) Humidity, relative or absolute
- 3) Temperature gradient
- 4) Atmospheric pressure
- 5) Precipitation
- 6) Solar radiation
- 7) Wind speed and direction
- 8) Frequency of readings
- 9) Source of data
- 10) Time in storage

6.2 TEST CONDUCT

NOTE: When conducting individual ammunition tests involving several subjects, samples and conditions i.e., range, temperature, position, etc., a "Latin Square" or comparable test design procedure will be imposed to assure a representative distribution of variables and minimum biasing.

6.2.1 Preoperational Inspection and Physical Characteristics

a. Upon receipt, carefully inspect all test items and comparison ammunition and their shipping or packaging containers for completeness, damage and general conditions in accordance with the applicable sections of MTP 10-4-500.

6.2.2 Firing Tests

6.2.1.1 Accuracy

6.2.2.1.1 Hand Fired Weapons

a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.

NOTE: Each phase of the subtest shall be conducted in ambient air temperature of 0°F to -25°F, -25°F to -45°F and -45°F to the lowest available temperature.

b. Install Standard American targets at a range of 25 meters, 15 meters and 10 meters

c. Zero all hand fired weapons at the 25 meter target. Record any difficulties encountered.

- d. Five test personnel shall fire three, 10-round shot groups utilizing the bench rest position.
- e. Utilizing the 15 and 10 meter targets repeat steps c and d above.
- f. Repeat the above steps using comparison ammunition.

6.2.2.1.2 Shoulder Fired Weapons

a. Semiautomatic fire

- 1) Cold-soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.
- 2) Install type A and B rifle targets at 25 meters.
- 3) Zero all shoulder fired weapons at 25 meters.
- 4) Five test personnel shall fire three 10-round groups (semiautomatic) at the type A target using the bench rest and weapon bipod.
- 5) Utilizing type B rifle target repeat steps 3 and 4 above.
- 6) Repeat the above steps using comparison ammunition.

b. Automatic Fire

- 1) Cold-soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.
- 2) Install type B rifle targets at 25 meters.
- 3) Zero all weapons at 25 meters.
- 4) Order five test personnel to assume a prone position and fire three 20-round groups in three to five round bursts.
- 5) Repeat the above steps using comparison ammunition.

NOTE: No support other than that provided by the rifleman (elbows) and weapon bipod shall be used.

- 6) After the procedures of 6.2.2 have been completed one third of the support weapons shall be fired 500 times in fifty round groups firing the weapon in semiautomatic and automatic.

c. Record the following data:

- 1) Difficulties in zeroing the weapons.
- 2) Number of rounds fired and percentage of hits within a 19-inch circle at each range for hand fired weapons.
- 3) Number of rounds fired and percentage of hits within a 40-inch circle of type A and B targets for shoulder fired weapons.
- 4) Ambient air temperature at test site.
- 5) Type ammunition fired.
- 6) Lot number of ammunition.
- 7) Ammunition malfunctions.

- 8) Weapon malfunctions contributed to ammunition such as carbon build up, broken parts
- 9) Mean radius, maximum vertical spread, maximum horizontal spread and total maximum spread.
- 10) Excessive noise.
- 11) Powder burns.

6.2.3 Velocity firing

- a. Place two velocity coils on a line of sight with the selected targets used in the accuracy subtest (6.2.2.1). The coils shall be separated by ten feet with the first coil five feet from the muzzle of the weapon, as shown in figure 1.
- b. Fire twenty-five rounds of test ammunition through the coils using appropriate weapons.
- c. Repeat step b, using twenty-five rounds of comparison ammunition.

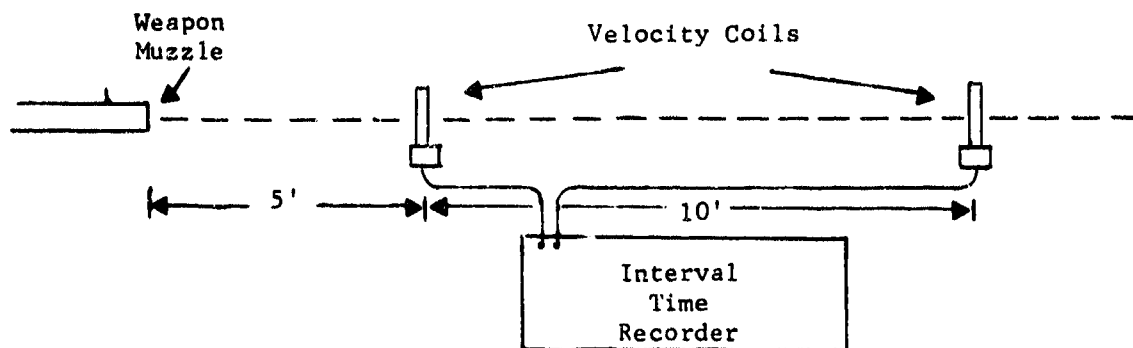


FIGURE - 1

- d. Record the following data:
 - 1) Velocity readings of test ammunition.
 - 2) Velocity readings of comparison ammunition.
 - 3) Ambient air temperature at test site.

6.2.4 Suitability of Tracer or Spotter Element

a. Tracer Element

- 1) Cold soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.

NOTE: Each phase of the subtest shall be conducted in ambient air temperature of 0°F to -25°F, -25°F to -45°F and -45°F to the lowest available temperature.

- 2) Install Standard American targets in squad formation at ranges of 150, 250 and 400 meters.
- 3) A automatic rifleman shall fire his weapon on full automatic to illuminate the targets and the remainder of the squad shall fire their weapons on semiautomatic.
- 4) The fire team leader shall designate targets for each squad member and shall attempt to illuminate the edges of the targets with the tracer cartridge and shall adjust fire on targets until all targets have been effectively engaged by the squad members.
- 5) The above exercise shall be conducted during the hours of overcast daylight and the hours of darkness.

NOTE: During the hours of darkness the targets shall be placed at a range of 50, 100, and 200 yards.

- 6) Repeat steps 2 through 5 using comparison ammunition.
- 7) Record the following data:
 - a) Ambient air temperature at time of firing.
 - b) Wind velocity and relative direction in relation to the gunner.
 - c) Weapon malfunctions contributed to the ammunition.
 - d) Ammunition malfunctions.
 - e) Number of rounds fired.
 - f) Effectiveness of test cartridge in illumination of targets during overcast daylight and darkness.
 - g) Number of target hits and range at which fired.
 - h) Percentage of tracer rounds that failed to ignite

b. Spotter Element

- 1) Cold soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.
- 2) Each phase of this subtest shall be conducted in ambient air temperature of 0°F to -25°F, -25°F to -45°F to the lowest available temperature.

NOTE: This subtest shall be conducted during the hours of daylight.

- 3) Install a simulated combat vehicle at a sufficient distance from the firing position so as to create a reasonable amount of difficulty for the gunner to engage.
- 4) Order each of five gunners to fire the .50 caliber spotter guns semiautomatic at the target until a spotting round strikes the target. Each gunner shall fire 3 additional rounds to confirm the accuracy of the ammunition.

- 5) Repeat steps b through d using comparison ammunition and record the following data:
 - a) Ambient air temperature at time of firing.
 - b) Wind velocity and relative direction in relation to gunner.
 - c) Weapon malfunctions attributed to the ammunition.
 - d) Percentage of spotting rounds that failed to ignite.
 - e) Number of rounds fired.
 - f) Number of target hits and range at which fired.

6.2.5 Position Disclosing Effect

- a. Cold soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.
- b. Each phase of this subtest shall be conducted in ambient air temperature of 0°F to -25°F, -25°F to -45°F and 45°F to the lowest available temperature.
- c. Mount cameras, perpendicular to the muzzle of the test weapons at a sufficient distance to photograph the flash.
- d. Position an observer behind each of five gunners and down range along one flank of the safety fan at range of 100, 200, 300, 400, 500 and 600 meters.

NOTE: Conduct this portion of test under darkened conditions.

- e. Order the test personnel to fire 20 rounds. Photograph the cumulative flash from each weapon.
- f. Record the following:
 - 1) Smoke, ice, fog and flash at firer positions.
 - 2) Sound, smoke and flash effects visible to the observers at indicated ranges.
 - 3) Annotations to the photographs of cumulative flash with regard to variations to flash during the test.
 - 4) Ambient air temperature at test site.
 - 5) Light conditions (daylight or darkness).
 - 6) Wind velocity and relative direction in relation to gunner.
- g. Repeat steps (c) through (f) above, utilizing the comparison weapons.
- h. Repeat steps (c) through (f) above, under daylight conditions but without photographing the cumulative flash.

6.2.6 Functional and Operational Suitability - Portability

- a. Cold soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.
- b. This test shall be conducted in ambient air temperature of 0°F to the lowest available.
- c. Inspect all test and comparison ammunition for loose, damaged

or missing parts and place in the best possible condition.

d. Pack the test and comparison ammunition in the prescribed carrying case and transport the items over the following courses:

- 1) Snowshoe three (3) miles through dense, snow-covered brush.
- 2) Snowshoe five (5) miles over open-covered (cross-country) terrain.
- 3) Ski ten (10) miles over cross-country trails.

e. Thoroughly inspect each test item for loose, damaged or missing parts, and record the following:

- 1) Damage attributed to environmental effects.
- 2) Problems encountered while transporting ammunition.
- 3) Damage to ammunition due to handling.
- 4) Temperature at test site.
- 5) Maximum load that can be carried in each mode of movement.

6.2.7 Aerial Delivery

a. Cold soak (outdoors for a period of at least 24 hours) all test and comparison ammunition.

b. This test shall be conducted in ambient air temperature of 0°F to the lowest available temperature.

c. Inspect all test and comparison ammunition for loose, damaged or missing parts and place in the best possible condition.

d. Subject all test and comparison ammunition to three parachute jumps under the following conditions.

- 1) Each parachutist shall be equipped with standard equipment and will jump in accordance with latest TM's.
- 2) Each test and comparison item shall be packed in an M 1950, Parachutists Adjustable Individual Container (or latest standard container) and attached to the parachutist's person as described in appropriate TM's.

e. Inspect all test and comparison items after each jump for damage and proper operation.

f. Subject the test and comparison ammunition to the air drop and ballistic evaluation procedures as described in MTP 4-2-509.

g. Record the following data:

- 1) Altitude and speed of delivery aircraft.
- 2) Ambient air temperature.
- 3) Results of inspections.
- 4) Malfunctions of test and comparison ammunition.
- 5) Methods used for attachment of ammunition to parachutists.
- 6) Compatibility with parachute equipment.
- 7) Method used for rigging and airdrop of ammunition.

6.2.8 Human Factors Evaluation and Safety

a. Conduct all Human Factors and Safety tests in accordance with the applicable sections of MTP 10-4-500.

b. Conduct these tests concurrently with the operational tests (Firing, Velocity, Suitability of Tracer or Spotter Element, Position Disclosure, Functional and Operational Suitability and Aerial Delivery, as described in this MTP.

6.2.9 Maintenance Evaluation

a. Conduct all maintenance evaluation tests (maintenance and reliability) in accordance with applicable sections of MTP 10-4-500.

b. Conduct these tests concurrently with the operational tests (Firing, Velocity, Suitability of Tracer or Spotter Element, Position Disclosure, Functional and Operational Suitability and Aerial Delivery, as described in this MTP.

6.3 TEST DATA

All test data to be recorded will be as specified in the individual subtests of this MTP.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing marking for identification and correlation, and grouping the test data according to test title.

Specific instructions for the reduction and presentation of individual test data are outlined in the succeeding paragraphs.

6.4.1 Preoperational Inspection and Physical Characteristics

Preoperational inspection and physical characteristics data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.2 Firing Tests

Compare mean radius, percentage of hits, and cyclic rate of fire to weapon specifications for possible deviations due to effects of arctic winter environmental conditions.

6.4.3 Velocity Tests

Velocity data recorded from the test ammunition shall be compared with recorded velocity data from comparison ammunition and accepted military standards to determine the effect caused by exposure to arctic conditions.

6.4.4 Suitability of Tracer or Spotter Element

The data obtained from the test shall be compared with appropriate

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QMR's, SDR's, TC's and accepted military standards.

6.4.5 Position Disclosing Effect

Compare data obtained from the test ammunition to the data obtained from the comparison ammunition and also against accepted military standards.

6.4.6 Functional and Operational Suitability

The operation of the ammunition under test in extreme arctic winter conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to the ammunition attributed to environmental effects of handling shall be compared with ammunition specifications contained in appropriate QMR and TC.

6.4.7 Aerial Delivery

The suitability of the ammunition under test for airborne operations under arctic winter environmental conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to and/or malfunctions of the weapons attributed to parachute jumps contained in appropriate QMR or TC.

6.4.8 Human Factors Evaluation and Safety

Human Factors and Safety data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.9 Maintenance Evaluation

Maintenance data shall be reduced and presented in accordance with MTP 10-4-500.

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GLOSSARY

1. Maximum Vertical: Vertical distance between the center of the hole made by the uppermost shot and the center of the hole made by the lowermost shot.
2. Maximum Horizontal: Horizontal distance between the center of the hole made by the shot farthest to the right and the center of the hole made by the shot farthest to the left.
3. Maximum Spread: Distance between the centers of the shot farthest apart.
4. Mean Radius: Arithmetic mean of the distances between the centers of all shot holes and a point of the target called Center of Impact.
5. Center of Impact: Defined as the point at which the algebraic sum of the components of the distances to the center of each shot hole is zero.

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